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(54) Joint prosthesis

(57) A prosthesis for a joint, especially a knee joint, between bones comprising a first component adapted for connection to a first bone and having a convex portion which engages a bearing portion on a second component adapted for connection to a second bone, and in relation to which said convex portion can roll and/or slide when said first component is angularly displaced rearwardly from an extended position to a flexed position, link means extending between the components which are pivoted to the first component, which can slide in the second component in a direction towards the first component and which are mounted therein to allow or cause the position of engagement of the convex portion on the bearing portion to vary in a direction or directions extending forwardly and rearwardly when the joint is flexed.

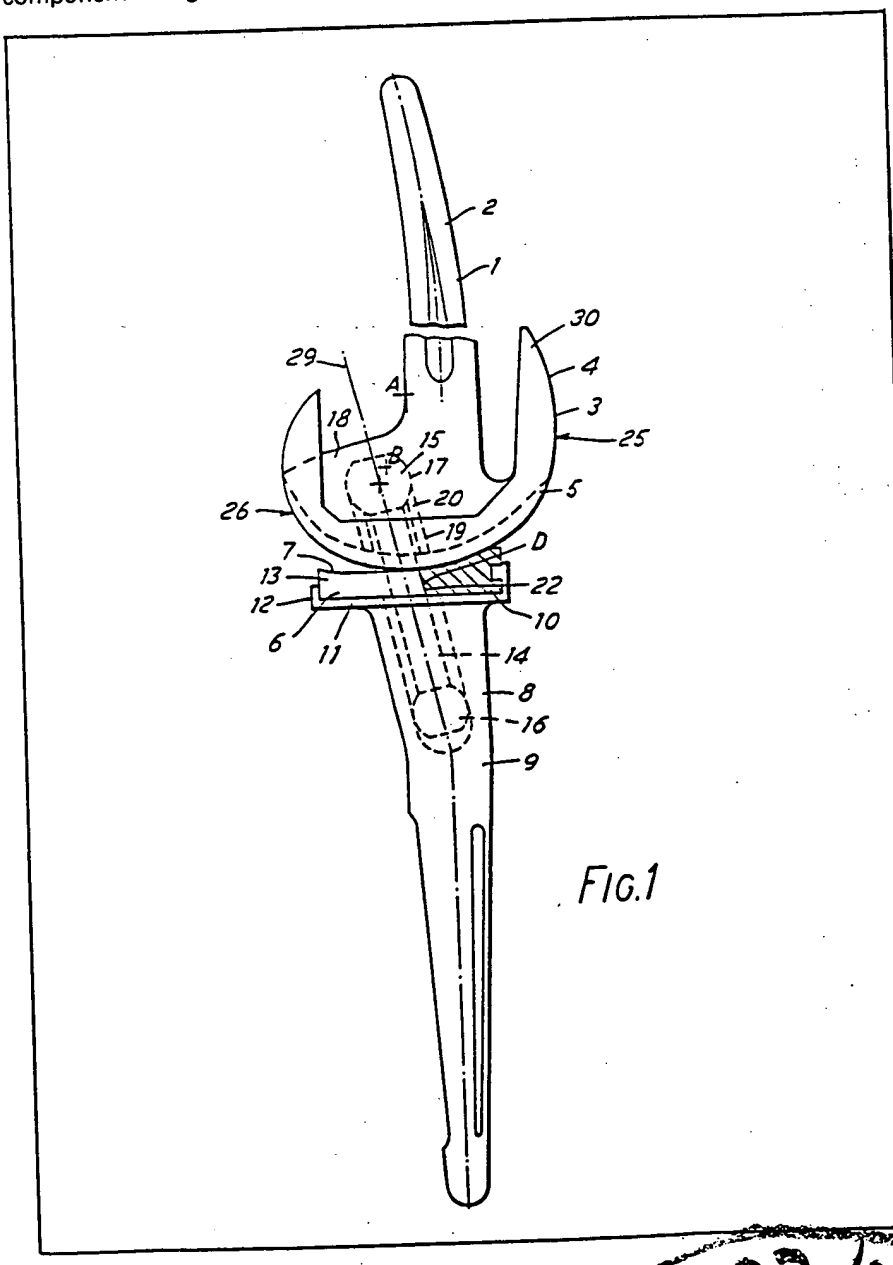

FIG.1

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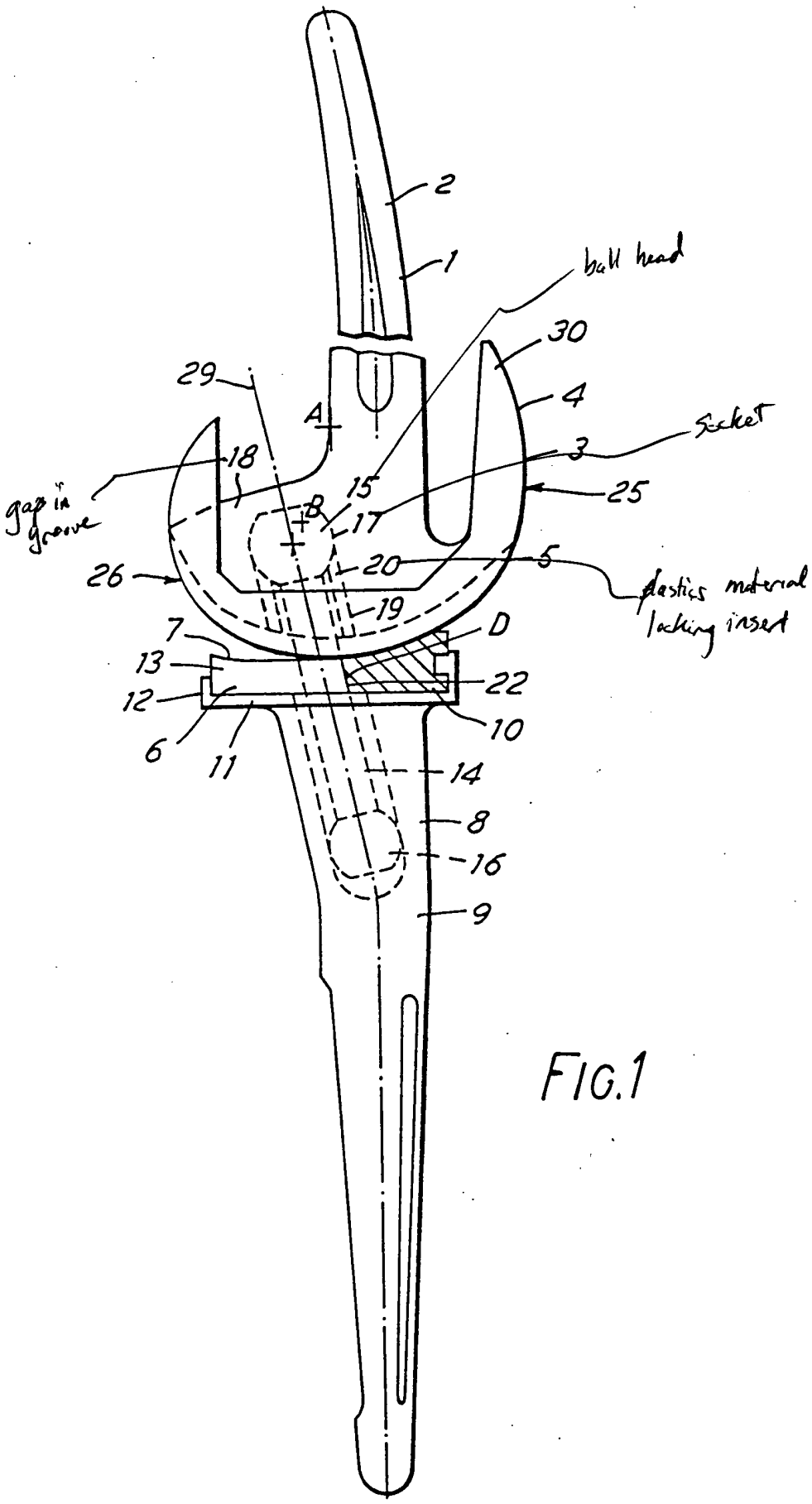
2
1
ball head
30
29
4
A
socket
3
18
gap in groove
15
25
8
17
20
5
26
plastics material locking insert
19
7
D
13
22
12
10
6
11
14
8
16
9

FIG.1

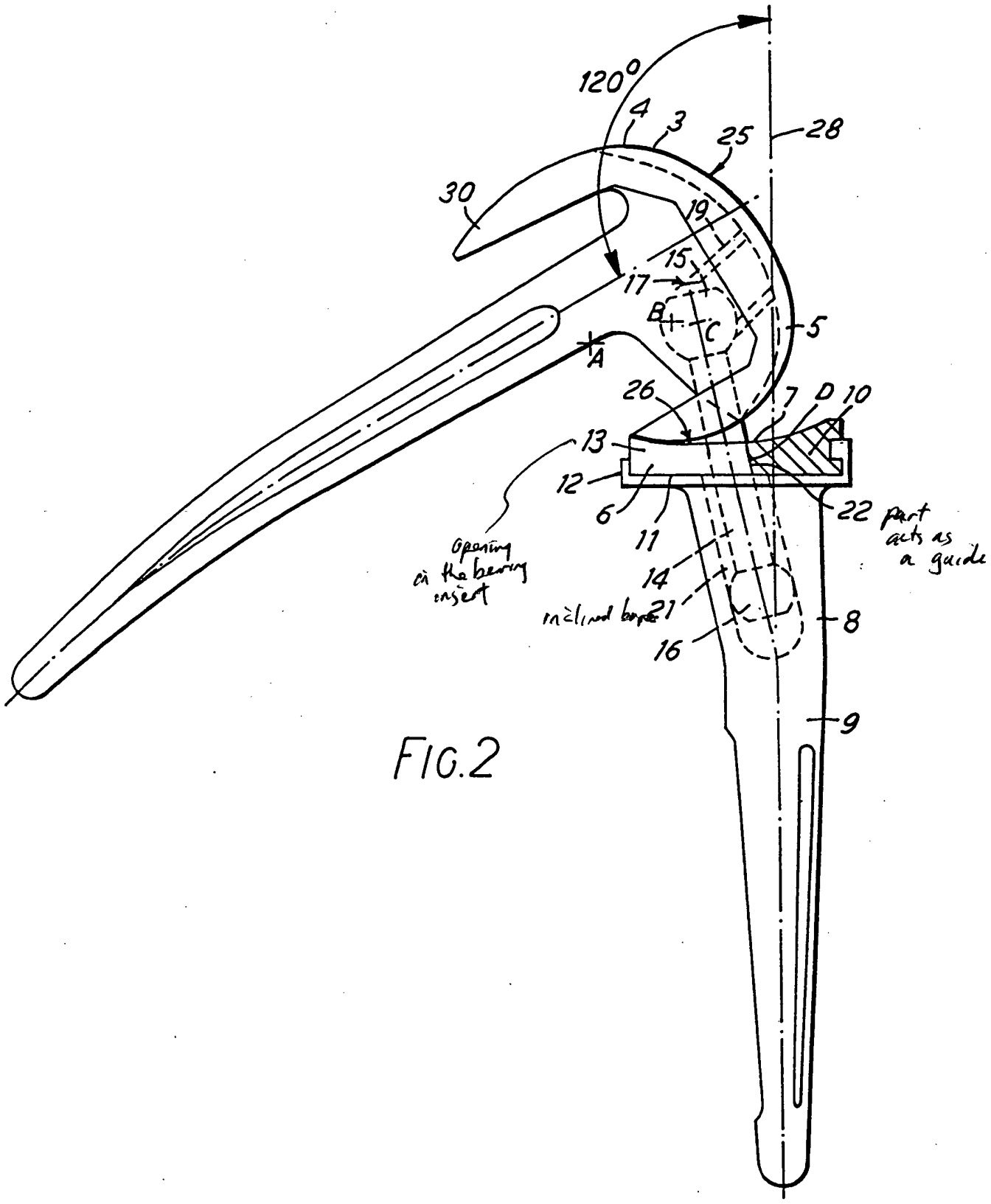
120°
4
3
25
28
30
19
15
17
B
C
5
A
26
7
D
10
13
12
6
11
22
part acts as a guide
Opening in the bearing insert
14
inclined bore
21
8
16
9

FIG.2

SPECIFICATION
Joint prosthesis

This invention relates to a joint prosthesis which is particularly although not exclusively applicable for use as a human knee joint.

In a known type of knee joint prosthesis as shown in UK Patent Application 2 088 724 a first component is provided which has a convex surface which engages a concavely curved surface on a second component. The components are interconnected by a link member which has an enlarged head captively located in a cavity in the first component. The cavity can be formed as a plastic insert and has an elongate shape, which can be straight or curved and through which a camming action causes flexion of the joint to be accompanied by a rearward sliding movement of the first component on the second component thus increasing the range of permitted flexion of the joint.

A disadvantage of this earlier construction is the difficulty in designing the shape of the cavity in the insert and in the rearward movement which will tend to be jerky as the enlarged head moves out of the position in which it is located when the components are in their extended positions.

The present invention is intended to provide a construction in which a rearward movement of a first component on a second component is allowed or caused by or during flexion of the joint.

The term "rear" is used herein to define the side of the joint towards which the components move when the joint is flexed. Thus, in a knee joint this would be the posterior side of the joint. If the invention is employed in other joints however, it might be the anterior side of the joint, for example, if the joint is used in an elbow.

According to the present invention a prosthesis for a joint between bones comprises a first component adapted for connection to a first bone and having a convex portion which engages a bearing portion on a second component adapted for connection to a second bone, and in relation to which said convex portion can roll and/or slide when said first component is angularly displaced rearwardly from an extended position to a flexed position, link means extending between the components which are pivoted to the first component, which can slide in the second component in a direction towards the first component and which are mounted therein to allow or cause the position of engagement of the convex portion on the bearing portion to vary in a direction or directions extending forwardly and rearwardly when the joint is flexed.

Thus, according to one aspect of the invention the link means can slide and pivot about a movable axis in the second component thus allowing the relative movement between the convex portion and the bearing portion when the joint is flexed.

In order to provide controlled relative movement the said link means can be guided to slide in the second component along an axis extending rearwardly and towards the first component, the link means being located in the first component so that the link pivot to the first component is moved away from the second component when the joint is flexed to cause the first component to move rearwardly in relation to the second component.

In a second construction the link means can include a link member one end of which is pivoted to the first component and the other end of which is guided to slide in a bore in the second component and oblique to a general longitudinal axis thereof.

If desired means can also be provided for allowing the link means limited free rearward movement in relation to the guided movement to accommodate variation to the movement between the first and second component when the joint is flexed and which can be caused, for example, by the shape of the convex portion and/or by the mutual requirements of the muscles and ligaments in the joint when located in position.

The bearing portion on the second component can have an opening through which the link means extend into the second component, part of the edge of this opening acting as part of the guide for the sliding movement of the link means.

Thus, the edge part can act to restrict forward movement of the link means and in a preferred construction the edge part is made from a synthetic plastics material.

The convex portion of the first component can have one or more axes of curvature, the pivot axes of the link means to the first component being disposed close to the convex surfaces on said convex portion than said axis or axes of curvature.

Preferably said pivot axis is disposed rearwardly of the axis or axes of curvature when the first component is in its extended position.

Thus, in the constructions in which there is guided control of the rearward movement this particular construction provides a convenient way of lifting the link member as the joint is flexed, this linking movement creating a rearward component of movement in relation to the second component which thus moves the first component rearwardly.

Preferably the link means also provide for relative rocking movement between the members normal to the axis of flexing movement to accommodate the natural movement of the joint.

In any case, the link member can be connected to the first component by a universal joint.

Conveniently the link means can be provided with a ball shaped end which is located in said second component in which it can pivot and slide.

The invention can be performed in various ways but one embodiment will now be described by way of example and with reference to the accompanying drawings in which:—

Figure 1 is a diagrammatic side elevation of a prosthesis according to the invention; and,

Figure 2 shows the same prosthesis in a flexed position.

As shown in the drawings the prosthesis is

intended for use as a knee joint and comprises a first component 1 having a stem for introduction into the inter-medullary canal of a femur. The lower end of the component 1 has a convex portion 3 which has convex bearing surfaces 4. This convex portion 3 is formed as two spaced apart bearing surfaces with a groove 5 between them thus reproducing the condyles of the natural bone.

The bearing surfaces 4 of the convex portion 3 engage a bearing portion 6 having spaced apart bearing surfaces 7 on a second component 8. This component also has a stem 9 for introduction into the inter-medullary canal of a tibia. The bearing surfaces 7 are formed on a bearing pad 10 made from a synthetic plastics material, for example ultra high density polyethylene, which is located in a tray 11 having side walls 12.

The two spaced apart bearing surfaces 7 have an opening 13 which extends rearwardly from approximately a mid-point in the width of the bearing surfaces as will be clear from the drawings.

Link means in the form of a link member 14 extend between the first component 1 and second component 8, the upper end of the link member having a ball portion 15 and at the lower end a ball portion 16. The upper ball is held in a part-spherical location socket 17 in the first component. The rearward end of this socket opens through a gap 18 to the groove 5. Leading from the socket 15 is an open sided bore 19, the open side of which also opens to the gap 18. The ball head 15 is held in place in the socket 17 by means of a plastics material locking insert 20 which slides into the open sided bore 19 from below thus retaining the ball head 15 in place.

The ball member 16 on the lower end of the link member 14 is located in an inclined bore 21. This bore extends from approximately the centre line of the stem 9 rearwardly and upwardly towards the first component 1, again as will be clear from the drawings. The angle of inclination is approximately 12°. The opening 13 in the bearing insert 6 is dimensioned so that part of the bearing insert projects rearwardly over part of the bore 21 so that a part 22 of the edge of the opening 13 acts as a guide for the forward edge of the link member 14, the ball 16 also acting as a guide for the lower part of the link member in the bore 21.

From the above it will be appreciated that the ball head 15 in the socket 17 provides a universal joint between the link member and the first component 1 and the ball head 16 at the lower end of the link member being located in the bore 21 to provide a sliding pivot for the link member in the second component 8.

The convex surfaces 3 comprise a first portion 25 having a centre A and a second portion 26 having a centre B. The centre of the pivot for the link member is indicated by reference letter C.

As shown in Figure 1 the joint is shown in the extended position. Figure 2 shows the joint with the first component 1 moved angularly to a flexed position. The amount of movement from a vertical axis 28 passing through the stem 9 of the second component 8 is approximately 120°.

The convex surfaces 25 and 26 are arranged so that the portion 25 having a centre A is in contact with the tibial plateau provided by the bearing pad 10 over the first 16° of flexion. B is the centre of the posterior radius which makes contact with the tibial plateau in the range from 16° flexion to full flexion (approximately 120°). As will be seen at the position of Figure 1 the pivot point C is closer to the convex surfaces than the centres A and B, it is also somewhat to the rear. As a result when the joint is flexed there is a lever movement first between the points A and C over the first 16° of movement and then between the points B and C of the remaining amount of movement and this leverage causes the point C to rise relatively to the bearing surface 7. This rising movement along the inclined axis 29 of the bore 21 causes the pivot centre C to move rearwardly due to the rearward inclination of the axis. As a result the first component 1 is moved backwards along the tibial plateau provided by the bearing surface 7. The link member 14 bears against the engagement portion 22 of the insert 10 thus ensuring that the rearward movement takes place.

It will be seen however that the link could move rearwardly as there is room between its sides and the sides of the bore 21. Thus, if the shape of the convex surfaces required it or if the natural inclination of the knee joint when assembled desired to do this further backward movement can take place at any time, this being accommodated by the limited free rearward movement of the link member.

If desired, and in certain constructions it might be desirable, to allow the forwards and backwards movements to take place freely, in which case the portion 22 of the insert 13 can be cut away to allow free forwards and backwards movement of the link pin thus enabling the joint to function as desired by the natural movement of the knee in which it is inserted. Again, the joint can be inserted into the knee so that the link member 14 is relatively free of the guide edge 22 and some forward movement can take place before it engages.

It will be appreciated that due to the inconsistencies in human joints it may be necessary to set up a prosthesis in various ways which may or may not require the control of rearward movement of the femoral component 1.

The thickness of the insert 20 is arranged so that in the extended position there is little or no rocking movement but this movement is increased during flexion so that there can be sideways movement of the link 14 in all directions thus providing a relative rocking movement between the first and second components normal to the axis of the flexing movement between them when flexed. This is again desirable to take up movement as desired by a natural knee.

The rocking movement referred to and fore and aft flexing movements of the knee are well known in themselves and are not therefore being

described further.

As described above the joint is intended for use in a human knee and a patella flange 30 is provided on the first component 1. The invention is not restricted to knee joints however and could be used in various other joints of the body. In this respect it will be appreciated that the terms "rear" and "forward" referred to in the specification are intended to be related to the flexing movement and thus, in the knee joint described above the side which is referred to as the rear is the posterior side of the joint but if, for example, the joint was used in an elbow then this side would be the anterior side.

CLAIMS

1. A prosthesis for a joint between bones comprising a first component adapted for connection to a first bone and having a convex portion which engages a bearing portion on a second component adapted for connection to a second bone, and in relation to which said convex portion can roll and/or slide when said first component is angularly displaced rearwardly from an extended position to a flexed position, link means extending between the components which are pivoted to the first component, which can slide in the second component in a direction towards the first component and which are mounted therein to allow or cause the position of engagement of the convex portion on the bearing portion to vary in a direction or directions extending forwardly and rearwardly when the joint is flexed.

2. A prosthesis as claimed in claim 1 in which said link means can slide and pivot about a movable axis in the second component.

3. A prosthesis as claimed in claim 1 in which the said link means are guided to slide in the second component along an axis extending rearwardly and toward the first component and is located in the first component so that the link pivot to the first component is moved away from the second component when the joint is flexed to cause the first component to move rearwardly in relation to the second component.

4. A prosthesis as claimed in claim 3 in which said link means includes a link member one end of which is pivoted to the first component and the other end of which is guided to slide in a bore in the second component and oblique to a general longitudinal axis thereof.

5. A prosthesis as claimed in claim 4 in which means are provided for allowing said link means limited free rearward movement in relation to the guided movement to accommodate variations in the movement between the first and second component when the joint is flexed.

6. A prosthesis as claimed in claims 3, 4 or 5 in which the bearing portion on said second component has an opening through which said link means extend into the second component, part of the edge of said opening acting as part of said guide for the sliding movement of said link means.

7. A prosthesis as claimed in claim 6 in which said edge part acts to restrict forward movement of the link means.

8. A prosthesis as claimed in claim 7 in which said edge part is made from a synthetic plastics material.

9. A prosthesis as claimed in any one of the preceding claims in which the convex portion of the first component has one or more axes of curvature, the pivot axis of the link means to the first component being disposed closer to the convex surfaces on said convex portion than said axis or axes of curvatures.

10. A prosthesis as claimed in claim 9 in which said pivot axis is disposed rearwardly of said axis or axes of curvature when the first component is in its extended position.

11. A prosthesis as claimed in any one of the preceding claims in which said link means also provides for relative rocking movement between the members normal to the axis or axes of flexing movement.

12. A prosthesis as claimed in any one of the preceding claims in which said link means is connected to the first component by a universal joint.

13. A prosthesis as claimed in any one of the preceding claims in which said link means are provided with a ball shaped end which is located in said second component in which it can pivot and slide.

14. A prosthesis for a joint between bones substantially as described herein with reference to and as shown in the accompanying drawings.

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